

WHAT IS CLAIMED IS:

1                   1.       A system for forming and quenching glass sheets, comprising:  
2                   a furnace having entry and exit ends and including a heating chamber  
3 having a conveyor for conveying glass sheets along a direction of conveyance  
4 through the furnace from the entry end to the exit end;  
5                   the exit end of the furnace including a roll bending station within the  
6 heating chamber, the roll bending station including a roll conveyor having  
7 horizontally extending conveyor rolls that are rotatively driven and spaced  
8 horizontally within the heating chamber along the direction of conveyance extending  
9 laterally with respect thereto to support and convey the heated glass sheets, the roll  
10 bending station having a pair of sets of bending rolls that are spaced laterally with  
11 respect to each other within the heating chamber along the direction of conveyance,  
12 and a drive mechanism that supports each set of the bending rolls with the rolls  
13 thereof at progressively increasing inclinations along the direction of conveyance  
14 and that provides rotational driving of the bending rolls to provide bending of the  
15 conveyed glass sheets along a direction transverse to the direction of conveyance;  
16                   a press bending station located externally of the furnace downstream  
17 along the direction of conveyance from the exit end of the furnace to receive the  
18 bent glass sheets from the exit end of the furnace, the press bending station having  
19 a lower ring mold and an upper press mold that have curved shapes along and  
20 transverse to the direction of conveyance, and an actuator that provides relative  
21 vertical movement between the lower ring mold and the upper press mold to bend  
22 a glass sheet therebetween and cooperate with the roll bending station in forming  
23 the glass sheet with curvatures both along and transverse to the direction of  
24 conveyance; and  
25                   a quench station for rapidly cooling the formed glass sheet to provide  
26 toughening.

1                   2.       A system for forming and quenching glass sheets as in claim  
2 1 the drive mechanism is located externally of the furnace with the bending rolls  
3 projecting inwardly into the furnace.

1                   3.     A system for forming and quenching glass sheets as in claim  
2     1 wherein the press bending station actuator moves the lower ring mold vertically  
3     to provide the glass sheet forming.

1                   4.     A system for forming and quenching glass sheets as in claim  
2     1 wherein the press bending station actuator moves the upper press mold vertically  
3     to provide the glass sheet forming.

1                   5.     A system for forming and quenching glass sheets as in claim  
2     1 wherein the press bending station actuator moves both the lower ring mold and  
3     the upper press mold vertically to provide the glass sheet forming.

1                   6.     A system for forming and quenching glass sheets, comprising:  
2                   a furnace having entry and exit ends and including a heating chamber  
3     having a conveyor for conveying glass sheets along a direction of conveyance  
4     through the furnace from the entry end to the exit end;  
5                   the exit end of the furnace including a roll bending station within the  
6     heating chamber, the roll bending station including a roll conveyor having  
7     horizontally extending conveyor rolls that are rotatively driven and spaced  
8     horizontally within the heating chamber along the direction of conveyance extending  
9     laterally with respect thereto to support and convey the heated glass sheets, the roll  
10    bending station having a pair of sets of bending rolls that are spaced laterally with  
11    respect to each other within the heating chamber along the direction of conveyance,  
12    and a drive mechanism that is located externally of the furnace and that supports the  
13    bending rolls at progressively increasing inclinations along the direction of  
14    conveyance as well as providing rotational driving of the bending rolls to provide  
15    bending of the conveyed glass sheets along a direction transverse to the direction  
16    of conveyance;  
17                  a press bending station located externally of the furnace downstream  
18    along the direction of conveyance from the exit end of the furnace to receive the  
19    bent glass sheets from the exit end of the furnace, the press bending station having  
20    a lower ring mold and an upper press mold that have curved shapes along and  
21    transverse to the direction of conveyance, and an actuator that moves both the lower

22 ring mold and the upper press mold vertically to bend a glass sheet therebetween  
23 and cooperate with the roll bending station in forming the glass sheet curvatures  
24 both along and transverse to the direction of conveyance; and  
25 a quench station for rapidly cooling the formed glass sheet to provide  
26 toughening.

1 7. A method for forming and quenching glass sheets comprising:  
2 conveying a glass sheet within a heating chamber of a furnace  
3 from an entry end thereof toward an exit end thereof to provide heating thereof for  
4 forming;  
5 continuing to convey the heated glass sheet on rotary horizontally  
6 extending rolls within the furnace heating chamber adjacent the exit end of the  
7 furnace and engaging opposite lateral sides of the roll conveyed glass sheet with a  
8 pair of sets of rotatively driven bending rolls that are spaced laterally from each  
9 other within the furnace heating chamber with each set having a plurality of bending  
10 rolls spaced along the direction of conveyance with progressively increasing  
11 inclinations to provide bending of the conveyed glass sheets along a direction  
12 transverse to the direction of conveyance;  
13 conveying the bent glass sheet out of the heating chamber of the  
14 furnace through the exit end thereof to between a lower ring mold and an upper  
15 press mold that have curved shapes along and transverse to the direction of  
16 conveyance;  
17 providing relative vertical movement between the lower ring mold  
18 and the upper press mold to bend a glass sheet therebetween and cooperate with the  
19 initial roll bending to form the glass sheet curvatures both along and transverse to  
20 the direction of conveyance; and  
21 thereafter rapidly cooling the formed glass sheet to provide  
22 toughening.

1 8. A method for forming and quenching glass sheets as in claim  
2 7 wherein each set of bending rolls is rotatively supported and driven from  
3 externally of the furnace with the bending rolls thereof projecting into the heating  
4 chamber.

1                    9.        A method for forming and quenching glass sheets as in claim  
2        7 wherein the lower ring mold is moved vertically to press bend the glass sheet.

1                    10.      A method for forming and quenching glass sheets as in claim  
2        7 wherein the upper press mold is moved vertically to press bend the glass sheet.

1                    11.      A method for forming and quenching glass sheets as in claim  
2        7 wherein both the lower ring mold and the upper press mold are moved vertically  
3        to press bend the glass sheet.

1                    12.      A method for forming and quenching glass sheets comprising:  
2                                conveying a glass sheet within a heating chamber of a furnace  
3        from an entry end thereof toward an exit end thereof to provide heating thereof for  
4        forming;

5                                continuing to convey the heated glass sheet on rotary horizontally  
6        extending rolls within the furnace heating chamber adjacent the exit end of the  
7        furnace and engaging opposite lateral sides of the roll conveyed glass sheet with a  
8        pair of sets of bending rolls that are rotatively supported and driven from externally  
9        of the furnace and spaced laterally from each other with each set having a plurality  
10       of bending rolls projecting into the heating chamber and spaced along the direction  
11       of conveyance with progressively increasing inclinations to provide bending of the  
12       conveyed glass sheets along a direction transverse to the direction of conveyance;

13                                conveying the bent glass sheet out of the heating chamber of the  
14       furnace through the exit end thereof to between a lower ring mold and an upper  
15       press mold that have curved shapes along and transverse to the direction of  
16       conveyance;

17                                moving both the lower ring mold and the upper press mold vertically  
18       to bend a glass sheet therebetween and cooperate with the initial roll bending to  
19       form the glass sheet curvatures both along and transverse to the direction of  
20       conveyance; and

21                                thereafter rapidly cooling the formed glass sheet to provide  
22       toughening.